

1 CLAIMS

What is claimed is:

- 1 1. A probe apparatus, comprising:
- 2 a first positioning unit configured to be optionally added onto a probe
- 3 station platform;
- 4 a probe arm attached to the first positioning unit;
- 5 a second positioning unit attached to the probe arm;
- 6 a cantilever attached to the second positioning unit, the cantilever having a
- 7 tip, the first and second positioning units configured to position the tip over a
- 8 device under test (DUT), the probe apparatus including an electrical signal path
- 9 between the tip of cantilever and probe station user instruments; and
- 10 a motion sensor configured to detect motion of the cantilever.

- 1 2. The probe apparatus of claim 1 wherein the cantilever is micro-
- 2 machined.

- 1 3. The probe apparatus of claim 1 wherein the first positioning unit
- 2 comprises mechanical screws.

- 1 4. The probe apparatus of claim 1 wherein the second positioning unit
- 2 comprises piezoelectric elements.

1           5. The probe apparatus of claim 1 wherein the second positioning unit  
2 comprises voice coil positioners.

1           6. The probe apparatus of claim 1 wherein motion of the cantilever is used  
2 to obtain an image of a surface of the DUT.

1           7. The probe apparatus of claim 6 wherein non-contact forces between the  
2 cantilever and the DUT are measured to obtain the image.

1           8. The probe apparatus of claim 1 wherein motion of the cantilever is used  
2 to detect a signal in an electrical trace of the DUT.

1           9. The probe apparatus of claim 1 wherein the cantilever is used to supply  
2 a signal to an electrical trace of the DUT from the probe station user instruments.

1           10. The probe apparatus of claim 1 further comprising a buffer amplifier  
2 included in the electrical path from the tip the cantilever.

1           11. The probe apparatus of claim 10 wherein the cantilever is attached to  
2 a support structure attached to the second positioning unit, wherein the buffer  
3 amplifier is mounted on the on the support structure.

1           12. The probe apparatus of claim 10 wherein the buffer amplifier  
2 comprises a field effect transistor (FET) input buffer in relatively close proximity  
3 to the cantilever.

1           13. The probe apparatus of claim 1 further comprising a series resistor  
2 included in the electrical path from the tip the cantilever.

1           14. The probe apparatus of claim 13 wherein the cantilever is attached to  
2 a support structure attached to the second positioning unit, wherein the series  
3 resistor is mounted on the on the support structure.

1           15. The probe apparatus of claim 1 wherein the motion sensor utilizes a  
2 light bounce technique to detect motion of the cantilever.

1           16. The probe apparatus of claim 15 further comprising a mirror optically  
2 coupled between the cantilever and the motion sensor.

1           17. The probe apparatus of claim 16 wherein the mirror is positioned so as  
2 not to interfere with an optical path of an optical imaging system positioned to  
3 optically view the DUT.

1           18. The probe apparatus of claim 1 wherein the motion sensor senses  
2   optical interference of a light beam deflected off the cantilever with a reference  
3   light beam to detect motion of the cantilever.

1           19. The probe apparatus of claim 1 wherein the motion sensor senses a  
2   change in resistance of a resistor in the cantilever to detect motion of the  
3   cantilever.

1           20. The probe apparatus of claim 1 wherein the motion sensor senses a  
2   change in capacitance between the cantilever and an electrode positioned near the  
3   cantilever to detect motion of the cantilever.

1           21. The probe apparatus of claim 1 wherein the cantilever comprises a  
2   solid conductor.

1           22. The probe apparatus of claim 1 wherein the cantilever comprises a  
2   conducting material on another material.

*del*  
*#2*  
1           ~~23. A method for probing a device under test (DUT), comprising:~~  
2           ~~optionally adding a probe apparatus to a probe station platform;~~  
3           ~~coarsely positioning with a first positioning unit of the probe apparatus a~~  
4           ~~tip of a cantilever of the probe apparatus over a surface of the DUT;~~

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5           finely positioning with a second positioning unit attached to the first  
6           positioning unit the tip of the cantilever of the probe apparatus over the surface of  
7           the DUT; and  
8           sensing motion of the cantilever.

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1           24. The method for probing the DUT of claim 23 further comprising  
2           obtaining an image of the surface of the DUT.

1           25. The method for probing the DUT of claim 23 further comprising  
2           obtaining a signal in an electrical trace of the DUT.

1           26. The method for probing the DUT of claim 25 further comprising  
2           buffering the signal in the electrical trace of the DUT with a buffer amplifier  
3           included an electrical path from the tip of the cantilever relatively close to the tip  
4           of the cantilever.

1           27. The method of probing the DUT of claim 23 wherein sensing motion  
2           of the cantilever comprises:  
3           reflecting light from the cantilever; and  
4           detecting a change in an angle at which the light reflected from the  
5           cantilever.

1           28. The method of probing the DUT of claim 23 wherein sensing motion  
2 of the cantilever comprises detecting a change in a resistance of the cantilever  
3 responsive to a bending of the cantilever.

1           29. The method of probing the DUT of claim 23 wherein sensing motion  
2 of the cantilever comprises detecting a change in a capacitance between the  
3 cantilever and an electrode in close proximity to the cantilever, the change in the  
4 capacitance responsive to a bending of the cantilever.

*Sub 13*

1           ~~30.~~ A probe apparatus, comprising:  
2           ~~first positioning means for coarse positioning configured to be optionally~~  
3           ~~added onto a probe station platform;~~  
4           ~~a probe arm attached to the coarse positioning means;~~  
5           ~~second positioning means for fine positioning attached to the probe arm;~~  
6           ~~a cantilever attached to the second positioning unit, the cantilever having a~~  
7           ~~tip, the first and second positioning units configured to position the tip over a~~  
8           ~~device under test (DUT), the probe apparatus including an electrical signal path~~  
9           ~~between the tip of cantilever and probe station user instruments; and~~  
10          ~~motion sensor means configured to detect motion of the cantilever.~~

1           31. The probe apparatus of claim 30 wherein the electrical signal path  
2 includes buffer means relatively close to the tip of the cantilever for buffering an  
3 electrical signal from tip of the cantilever.

1           32. The probe apparatus of claim 30 wherein the electrical signal path  
2 includes resistive means relatively close to the tip of the cantilever for reducing a  
3 load on the DUT resulting from the cantilever.

1           33. The probe apparatus of claim 30 wherein the motion sensor means  
2 includes reflecting means for reflecting light reflected from the cantilever.